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DRAFT ENVIRONMENTAL EVALUATION WORK PLAN

FOR

OPERABLE UNIT 1

881 HILLSIDE

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Rocky Flats Plant

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1.0 INTRODUCTION

1.1 OBJECTIVE

The protection of wildlife, fisheries, threatened and endangered species, and important habitats is authorized through the Comprehensive Environmental Response, Compensations and Liability Act of 1980 (CERCLA) (as amended by Superfund Amendments and Reauthorization Act of 1986 [SARA]) and other statutes. The ecological assessment of hazardous waste sites is the activity through which pertinent information is gathered, and the environmental risk assessment utilizes these data and specific methodologies to evaluate potential impacts to environmental values and resources resulting from contaminant releases. The objective of the Environmental Evaluation Work Plan for 881 Hillside is to gather and analyze appropriate environmental data in order to determine whether the site poses a current or potential risk to environmental resources in the absence of any remediation.

1.2 SCOPE OF WORK

In order to accomplish the work plan objective, a number of activities are prepared and executed. These are briefly described below:

- Project Preparation. This activity represents the project planning, preparation of the work plan, and preparation of the sampling and analyses plan (SAP). The SAP incorporates two other supporting documents, the field sampling plan (FSP) and quality assurance project plan (QAPP). Included also is the review and analysis of existing information, identification of data gaps, and the preparation of a site-specific conceptual model of release, transport, and exposure.

- Field Investigation. This activity represents all Phase III remedial investigation and ecological assessment fieldwork, including the installation of monitoring wells, soil borings, sampling and analysis of ground and surface waters, collection and analysis of soil

scrapes, collection and analysis of biological samples, and air quality sampling necessary for the baseline risk assessment.

- Data Analysis. During data analysis, all collected field data are reduced, evaluated, compared with, and integrated into the existing data bank to provide up-to-date information on conditions. A second activity is to identify and provide data on specific chemical/radiological contaminants, transport mechanisms, and environmental receptors in order to conduct the baseline risk assessment.

- Environmental Risk Assessment. The environmental risk assessment incorporates the environmental data gathered in the previous activities, characterizes documented or potential contaminant exposure pathways and exposure point concentrations, and assesses the risk or threat to wildlife, protected species, or habitats.

- Remediation Criteria. Statutes require the selection of remedial actions sufficient to protect the environment. This activity entails the consideration of federal and Colorado state laws and regulations pertaining to the preservation and protection of natural resources that are applicable or relevant and appropriate requirements (ARAR). Criteria that are usable and applicable for the environmental risk assessment are utilized to the extent they are available. Available data will be evaluated and, to the extent practicable, criteria will be established that address environmental protection.

- Environmental Evaluation Report. This activity entails the preparation of the report that addresses the scope of the investigation, site environmental characteristics and contaminants, characterization of exposure and risk, remediation criteria, conclusions, and limitations of assessment.

Elements of the Scope of Work are described in detail in the following sections.

2.0
PROJECT PREPARATION

An environmental evaluation at 881 Hillside is necessary so that the Rocky Flats Plant can meet the requirements of Sections 121(b)(1) and (d) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). This environmental evaluation, in conjunction with the human health risk assessment, is required to ensure that remedial actions are protective of human health and the environment. Guidelines for conducting this evaluation, which is also called an ecological assessment, are provided by EPA in Risk Assessment Guidance for Superfund, Volume II, Environmental Evaluation Manual (EPA, 1989). The evaluation is a qualitative and/or quantitative appraisal of the actual or potential effects of a hazardous waste site on plants and animals other than humans and domesticated species. It is intended to reduce the inevitable uncertainty associated with understanding the environmental effects of contaminants present at 881 Hillside and to give more definitive boundaries to that uncertainty during remediation.

As an integral part of the Remedial Investigation/Feasibility Study (RI/FS) process, the environmental evaluation will rely initially upon analyses of existing data to develop a conceptual model of 881 Hillside that can be used to assess both the nature and extent of contamination and to identify potential exposure pathways and environmental receptors.

2.1 WORK PLAN

This work plan for the implementation of the environmental evaluation at 881 Hillside was prepared to ensure that the review of existing data and the subsequent additional field investigations will be sufficient to ascertain the ecological effects of contaminants at the site. Media to be assessed include soil, ground water, surface water, air quality, and terrestrial and aquatic vegetation and animals. Determination of the need for additional samples and the locations thereof will be dependent upon development of receptor scenarios. If sufficient data are not available at primary receptor sites, additional samples will be collected. A detailed review of existing information on 881 Hillside, which will be an integral part of this environmental evaluation, will highlight data gaps and avoid duplication of effort.

Types of information required for this evaluation include:

- Aquatic and terrestrial field surveys to determine inhabitant species, soil types, and vegetation cover.
- Chemical analyses of air, soil, water, sediments, leachates, and biological tissues.
- Determination of sediment composition and quality, grain sizes, and total organic carbon.
- Toxicity test data to detect and measure the effects of contaminated environmental media on representative species.

The aquatic and terrestrial field surveys will provide data to assess ecological conditions in order to determine if these organisms have been adversely affected by contaminants at this site. The ecological assessment will be iterative. The initial scope of the investigation will include the collection of terrestrial vegetation and selected aquatic life species to determine if bioaccumulation is occurring. The soils, surface water, and ground water chemical data and biological parameters collected during this environmental evaluation will be utilized to assess both the current and future ecological impacts from 881 Hillside. If, during this first phase, it is found that bioaccumulation is occurring, additional key food chain species will be collected and analyzed, including small and large mammals, and fish species.

Toxicity tests will be conducted for the aquatic and terrestrial systems if the surveys indicate an impact. Environmental media toxicities can be estimated using either a chemistry-based approach or toxicity-based approach. The chemistry-based approach will first be applied where chemical analyses of media will be compared to literature criteria to estimate toxicity. ~~If this analysis fails to explain the contaminant impact on the biota,~~ the toxicity-based approach will be used. The toxicity-based approach involves the measurements of a biological effect associated with exposure to complex mixtures. For this study, toxicity testing will include acute and chronic toxicity methods for aqueous samples.

The concept of biomarkers is that selected endpoints (such as population-ecosystem density, diversity, or nutrient cycling), which are measured in individual organisms, are typically comprised of biochemical or physiological responses that can provide sensitive indices of exposure or sublethal stress. The most direct biomarker to assess exposure is to measure tissue residues, a key component of bioaccumulation. Biomarkers for sublethal stress include histopathology, determination of skeletal abnormalities, measurement of gas exchange in plants, and levels of certain enzymes. For this evaluation, toxicological endpoints for indicator or target species will be chosen based on a review of available laboratory toxicity tests providing quantitative data for species of concern. In the absence of toxicological indices for the target species, toxicological endpoints will be derived using safety factors that reflect interspecies extrapolation, acute-to-chronic extrapolations, and added protection for endangered and/or threatened species.

In presenting the conclusions of the environmental evaluation for the 881 Hillside area, the degree of success in meeting the overall objective of the evaluation will be discussed. Each conclusion will be presented along with items of evidence that would support or fail to support the conclusions and the uncertainty accompanying that conclusion. Any factors that limited or prevented development of definitive conclusions will also be described. Information will be provided to indicate the degree of confidence in the data that was used to assess the site and its contaminants.

2.2 SUPPORT DOCUMENTATION

In addition to the work plan, proper conduct of this environmental evaluation will be dependent upon development of:

- A plan for sampling environmental media
- A plan for preparation of environmental samples for analysis
- A plan for analyses of environmental media
- A Quality Assurance Project Plan (QAPP)

In concurrence with present EPA protocol, all these plans have been combined into the Sampling and Analyses Plan (SAP), which consists of two primary parts: 1) a QAPP that describes the policy, organization, functional activities, and quality assurance (QA) and quality control (QC) protocols necessary to achieve data quality objectives (DQO) dictated by the intended use of the data; and 2)

the field sampling plan (FSP) that provides guidance for all fieldwork by defining in detail the sampling and data-gathering methods to be used on a project. Guidance for the selection and definition of field methods, sampling procedures, and custody were acquired from the Compendium of Superfund Field Operations Methods, which is a compilation of demonstrated field techniques that have been used during remedial response activities at hazardous waste sites (U.S. EPA, September 1987, hereafter referred to as the Compendium). To the extent possible, procedures from the Compendium are incorporated by reference.

The purpose of the SAP is to ensure that sampling data collection activities will be comparable to and compatible with previous data collection activities performed at the site while providing a mechanism for planning and approving field activities. The plan also serves as a basis for estimating costs of field efforts for inclusion in the work plan. This Work Plan incorporates by reference FSPs, SOPs, and SAPs for media sampling as presented in the Phase III RI Work Plan (EG&G, 1990). Additional FSPs for biological sampling and air quality that do not appear in the Phase III RI Work Plan will be developed for the ecological assessment.

The format used for preparation of the SAP is presented in Table 2-1.

2.3 REVIEW OF EXISTING INFORMATION

As an essential part of the environmental evaluation of 881 Hillside, a review of documents and data relevant to the site will be completed. This will allow the compilation of a data base from which to determine data gaps and provide evidence for a defensible field sampling program.

During preparation of this work plan, several documents were reviewed as part of an assessment of available information. These included the Final EIS, Rocky Flats Plant, DOE, 1980; Wetlands Assessment, EG&G, 1990; Phase III RI/FS Work Plan, 881 Hillside Area, DOE 1990; Draft RI Report for the High Priority Sites 881 Hillside Area, RI, 1987, 1988; Draft Environmental Assessment for 881 Hillside, DOE, 1989; among others. A more complete literature search will be continued during implementation of this evaluation. Nonetheless, review of the information and the data summaries in the Phase III RI/FS Work Plan elucidates some preliminary data gaps and forms the basis for the establishment of the initial sampling locations to be discussed in the FSP.

TABLE 2-1
SUGGESTED FORMAT FOR SAP (FSP AND QAPP)

FSP

1. Site Background
2. Sampling Objectives
3. Sample Location and Frequency
4. Sample Designation
5. Sampling Equipment and Procedures
6. Sample Handling and Analysis

QAPP

Title Page

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1. Project Description
2. Project Organization and Responsibilities
3. QA Objectives for Measurement
4. Sampling Procedures
5. Sample Custody
6. Calibration Procedures
7. Analytical Procedures
8. Data Reduction, Validation, and Reporting
9. Internal Quality Control
10. Performance and Systems Audits
11. Preventative Maintenance
12. Data Assessment Procedures
13. Corrective Actions
14. Quality Assurance Reports

3.0
FIELD INVESTIGATION

3.1 SAMPLING ACTIVITIES

3.1.1 Air Quality

The purpose of the air quality monitoring for the Phase III RI field investigation is to assess the potential air quality impacts to the environment resulting from the following activities:

- Drilling and sampling of soils and wastes within the solid waste management units (SWMU)
- Installation of ground water monitoring wells

Locations of the air sampling should be upwind and downwind of the drilling activity. The sampling should occur continuously in conjunction with the drilling activities. Standard operating procedures (SOP) for each monitoring parameter will be developed for sampling and analysis. These SOPs will contain sampling procedures, detection limits, sample media, volume requirements, preservation requirements, and analytical procedures.

Based on the analytical results, time weighted average concentrations (such as 24-hour averages) will be calculated. These concentrations can then be compared to health-based standards, and risk assessments can be performed. A literature review will be performed to compare measured concentrations to concentrations considered to have significant impacts on flora and fauna.

3.1.2 Soils

Site-specific soil data currently exist for the 881 Hillside area. These data were collected as part of Phases I and II of the RI for 881 Hillside. The drilling was conducted to identify and characterize past waste disposal sites. Boreholes were drilled within and adjacent to the SWMU, and soil samples were collected and analyzed for organics, inorganics, metals, and radionuclides. Sequences of Rocky Flats Alluvium, Colluvium, Recent Valley Fill, and Arapahoe Formation were sampled and tested in the field and laboratory. The geologic and hydrologic data from Phase I and II drilling programs provided the basic framework for defining a chemical/hydrologic/geologic model for the 881 Hillside. Source contaminants and concentrations, as well as

possible flow paths, rates, and accumulations, could be preliminarily assessed to characterize the dynamic system.

However, volatile organics data for soils previously collected from the 881 Hillside area were rejected during the data validation process and cannot be used in a quantitative sense. Analytical results of all Phase I and II soil samples will be reviewed and interpreted for use in the ecological assessment.

The Phase III RI work plan proposes an additional soil sampling program for the 881 Hillside to further characterize the extent of contamination, gain additional hydrologic data, and resolve questions regarding the presence and concentration of volatile organics. Under the program, approximately 47 boreholes and 32 monitoring wells will be drilled in the 881 Hillside area. Test wells are designed to provide a continuous core of sediment, and will evaluate the Rocky Flats Alluvium, Colluvium, Recent Valley Fill, and upper section of the Arapahoe Formation. Soil samples will be analyzed for organics, inorganics, metals, and radionuclides.

As in prior programs, the soil sampling locations are placed in areas to characterize specific sites and regimens, and they do not form a random grid. However, sample density is considered sufficient to provide a clear picture of soil characteristics and contaminant concentrations for all sediment types found in the 881 Hillside area. The range of substances to be tested (Hazardous Substance List) is also considered sufficient for the ecological assessment.

Soil analysis results are related to surface and ground water regimens. Fluids moving through the soils can act to leach contaminants and transport them through available flow paths and deposit them in down gradient environments. Soil analyses will help define areas of contaminant sources as well as areas of accumulation.

The near surface (upper ~~20~~ 60 inches) soil samples will be of prime importance for determining source contaminants for biota. This upper zone provides the major source of nutrient and contaminant uptake for the vegetation under study. Sampling and analysis programs under Phase III RI field investigation will be reviewed and modified when necessary to ensure that sampling intervals and methods are appropriate to collect soils from the upper 20 inches. The initial data review suggests that sample locations and analyses appear to be adequate for the environmental evaluation, and these data will be interpreted and used as appropriate.

3.1.3 Surface Water

A summary of Phases I and II surface water sampling and analytical results is contained in the Phase III RI/FS Work Plan for 881 Hillside (EG&G, 1990). Approximately 10 surface water locations (SW 31, 35, 44, 45, 46, 66, 67, 68, 69, and 70) were sampled along the South Interceptor Ditch during Phases I and II (Phase III RI/FS Work Plan, EG&G, 1990). These locations (see Figure 2-17 in Phase III RI/FS Work Plan) are continuing to be sampled on a monthly basis through 1990 as part of the overall plant sampling program.

The following information is summarized from the Phase III RI/FS Work Plan (EG&G, 1990). Low levels of PCE were periodically detected at SW-45 and 46, but no other samples contained volatile organics during Phases I and II. The following metals were detected above background at various locations: Al, Be, Cd, Cu, Hg, Sr, Zn, and Cr. Uranium was the only radionuclide detected above background. In addition to the South Interceptor Ditch area, three locations (SW-32, 33, and 34) were sampled on Woman Creek during Phases I and II. No volatile organics or radionuclides were detected in Woman Creek. Only zinc was detected above background levels during Phases I and II. Samples are currently being collected monthly (through 1990) at these locations.

The chemical results from the 13 surface sampling locations discussed above will be reviewed and interpreted as part of the Phase III plan. Phase III will rely upon monthly results from the overall plant surface water sampling program. No additional sampling will occur specifically for Phase III.

The 13 sampling locations (Figure 2-17 Phase III RI\FS Work Plan) established near 881 Hillside as part of the overall plant sampling program appear to be adequate for the environmental evaluation. The list of analytes (Hazardous Substance List [HSL]) is adequate also. There is an apparent data gap; it is not clear whether or not all of the seeps or springs that may exist in the 881 Hillside have been located and sampled. Unidentified springs or seeps may support vegetation and wildlife. Therefore, a field reconnaissance program is planned for locating seeps and springs that are not currently being sampled. If any additional springs or seeps are identified during the field reconnaissance that may potentially impact wildlife, they will be added to the surface water sampling program currently underway in the area. Samples will be collected on a monthly basis and analyzed for HSL constituents and radionuclides. Analytical data collected from the 13 existing locations and any new sites will be utilized in the environmental evaluation of 881 Hillside.

3.1.4 Ground Water

The following paragraphs describe the ground water information in the 881 Hillside area and the nature and extent of ground water contamination based on past investigations. Ground water data gaps related to performing the environmental evaluation are also addressed.

The Phase III RI/FS Work Plan for 881 Hillside (EG&G, 1990) provided a detailed discussion of the planned Phase III ground water investigation and summarized the scope and results of previous Phases I and II ground water studies conducted in 1987. The results of the Phase I and II investigations along with planned Phase III activities for 881 Hillside were reviewed to determine if any data gaps existed that may impact preparation of an environmental evaluation for the 881 Hillside area. The results of the review are discussed below.

Approximately 25 shallow alluvial/colluvial and 7 deeper bedrock ground water monitoring wells were installed and sampled within and downgradient of the various SWMUs located on 881 Hillside during the Phase I and Phase II investigations. The Phase I and II hydrogeologic information and laboratory analytical data from ground water samples will be utilized in the environmental evaluation of the Site. For example, past investigations have established the following:

- Direction of shallow ground water flow
- Estimates of ground water flow velocities in alluvial/colluvial materials
- Estimates of hydraulic conductivities of various geologic units
- Potential ground water contaminants
- A preliminary description of contaminant source areas

This information will be used in assessing the impact of potential ground water contaminants on exposed biota populations selected for investigation.

These data will also aid in characterizing the nature and areal extent of ground water contamination in the vicinity of the site. The hydrogeologic information and laboratory analytical results from the planned Phase III boring and well installation program will likewise be used in the environmental evaluation. The major hydrogeologic tasks proposed for Phase III will provide the following data:

- Estimates of hydraulic conductivities of alluvial/colluvial and weathered bedrock materials
- Concentrations of chemical constituents in soil and ground water (primarily alluvial/colluvial wells)
- Subsurface geologic characteristics (primarily in the stratigraphic zone from ground surface to the top of unweathered bedrock)
- Characterization of vertical and lateral extent of contamination in the shallow colluvial/alluvial aquifer

The above information will be used to assess the nature and extent of contamination in shallow ground water and help identify exposure pathways for the environmental risk assessment.

Approximately 29 shallow colluvial/alluvial wells and 3 bedrock wells are planned in Phase III in the vicinity of the Site to better characterize contaminants identified in ground water during Phases I and II. Potential contaminants discovered in the ground water during Phases I and II consisted of:

- Volatile organic compounds (PCE, TCE, 1,1-DCE, 1,1-DCA, 1,1,1-TCA, 1,1,2-TCA, Carbon Tetrachloride)
- Metals above background (Mn, Se, Ni, Zn, Sr, Al, As, Ba, Cd, Cr, Cu, Fe, Pb, Li, Mg)
- Radionuclides (uranium)

It became apparent when reviewing results of past ground water studies and the planned Phase III activities that a preponderance of data collection (both chemical and physical) has been or will be focused on the shallow colluvial/alluvial ground water system. After implementing the proposed Phase III work plan, approximately 54 shallow colluvial/alluvial wells and only 10 bedrock wells will exist. Only 3 bedrock wells are planned for Phase III. Approximately 13 of 29 (45 percent) alluvial/colluvial wells were dry during the second quarter 1989 sampling. This may indicate that ground water flows through the alluvial/colluvial material in some areas of the site only during wetter periods of the year. The potential for downward ground water flow from the alluvial and unconfined aquifers into the unweathered bedrock aquifer, which may be a potential exposure pathway

toward Woman Creek, suggests that additional focus should be placed on ground water flow directions and extent of contamination within the bedrock, which underlies the unconsolidated material.

The hydraulic and ground water chemical data for the weathered bedrock zone underlying the site should be further evaluated to determine the appropriate locations and depths of additional deep wells that would be needed to characterize the vertical extent of ground water contamination. This potential data gap will be addressed as part of this environmental evaluation work plan. The following activities will be performed in a phased approach to further characterize ground water conditions in the bedrock unit:

- Review existing well completion data (that is, screen elevation, geologic material screened, historic water levels)

- Prepare hydrogeologic cross sections and schematic flow nets

- Develop a conceptual ground water flow model that considers the potential for flow from the alluvial system into the bedrock

- Install piezometer clusters to evaluate vertical flow components and test the conceptual flow model (number and location of piezometer will be based on evaluation of existing data)

- Install bedrock monitoring wells to characterize ground water quality and flow directions

- Use hydrogeologic, hydraulic head, and hydrochemical data from these wells as a basis for further characterizing the ground water flow system, extent of contamination, and potential exposure pathways considered in the environmental evaluation

The review of existing data will focus on well screen elevation, subsurface geology, and historic static water level data at the Site. Results of this hydrogeologic study will be included in a letter report including maps and cross sections. This letter report will also include a conceptual ground water flow model, developed and based on the above results, and schematic flow net diagrams. At this time, it is anticipated that it will be necessary to install several piezometer clusters to evaluate vertical flow components, consistent with the conceptual flow model. Potential vertical flow components and vertical pathways for contaminant migration will be considered in evaluating the appropriate locations of additional deep monitoring wells. It is estimated that piezometer

clusters at 3 to 5 locations may initially be required. Each of these piezometer clusters would likely consist of a piezometer in each of the following zones: 1) alluvium/colluvium, 2) upper weathered bedrock, 3) lower weathered bedrock, and 4) upper unweathered bedrock. The clusters will be located to take advantage of existing wells so that the overall number of piezometers can be reduced while still addressing the goal of defining the vertical hydraulic gradients. The actual piezometer clusters will be located based on the review of existing information.

Once these piezometric data are available to assess vertical gradients, additional weathered bedrock monitoring wells will be installed to collect the hydrochemical data needed to evaluate the vertical extent of ground water contamination. Additional bedrock well samples will be analyzed for the same parameters as those listed for Phase III ground water sampling. These data, along with contaminant types and concentrations will be used to further define the potential routes of exposure (discharge areas from bedrock units will be evaluated and presented in the environmental evaluation report for the Site.)

3.1.5 Terrestrial and Aquatic Biota

Little site-specific biological data exist for the Site. The ecological assessment field surveys will be conducted sufficient to characterize biological site conditions in terms of species presence, habitats characteristics, and/or community organization. The emphasis will be to describe the structure of the biological communities within the 881 Hillside area. An additional activity will be the collection of biological samples necessary to establish contaminant levels in tissues and to identify potential impacts from contaminant releases. Selected terrestrial, wetland, and aquatic species will be collected for tissue analyses. The emphasis is on lower tropic-level organisms since it is this level that is most likely to contain measurable amounts of contaminants in tissues.

Further sampling and analysis of higher trophic-level organisms will be predicated on the analytical results of this initial sampling.

3.1.5.1 Vegetation

The objectives of the vegetation sampling program are to provide data for 1) the description of site vegetation characteristics; 2) identification of potential exposure pathways from contaminant releases to higher trophic-level receptors; 3) identification of species that provide the most reasonable chance of detecting the biological uptake

of contaminants from site releases; 4) selection of key species for contaminant analysis to determine background conditions for the 881 Hillside area; and 5) identification of any protected vegetation species or habitats.

3.1.5.1.1 Terrestrial Vegetation. The vegetation of 881 Hillside is comprised mainly of grasses characteristic of the short grass plains. Representative species include slender wheatgrass (Agropyron trachycaulum) and green needlegrass (Stipa viridula), which are interspersed with a variety of annual flowering plants. Transects will be established along the hillside in a random procedure to collect vegetation phytosociological data on density, cover, frequency, and species presence. At selected locations, key species will be harvested (roots and leaves separately) for tissue analyses.

3.1.5.1.2 Wetland Vegetation. Wetlands have been identified along the South Interceptor Ditch below the Site and at the ravine bottom along Woman Creek (EG&G, 1990). These occur as linear wetlands; emergent and seasonal wetlands; emergent, intermittent, and temporary wetlands; and as open water and semipermanent wetlands. Species associated with these wetlands include broad-leaf cattail, baltic rush, silver sedge, cordgrass, and various bulrushes. Selected species from this list that occur below 881 Hillside will be harvested for tissue analyses at designated sampling locations.

3.1.5.1.3 Aquatic Vegetation. The periphyton community is a closely adhering group of organisms that form mat-like communities on rocks and other solid objects on the stream bottom. It is composed of algae, bacteria, fungi, detritus, and other macroscopic heterotrophic organisms. Because of the large surface-to-volume ratio of its constituents, the periphyton has been found to be an excellent indicator community for accumulation of contaminants. Periphyton samples will be collected at designated locations for contaminant analyses below the 881 Hillside in the South Interceptor Ditch, Woman Creek, and at Pond C-2.

3.1.5.2 Animal Life

A field survey will be performed to gather data sufficient to describe the animal communities on 881 Hillside to generalize key food chain species. Terrestrial herbivores (various arthropods and small mammals) and higher trophic-level species will not be collected for tissue analyses prior to obtaining and evaluating analytical results from vegetation tissue samples. The objective of the animal life sampling is to 1) describe the existing animal community in the 881 Hillside area; 2) identify potential contaminant pathways through consumer groups; 3) identify key species for potential collection and tissue analysis; and 4) identify any protected species.

4.0
DATA ANALYSIS

4.1 ENVIRONMENTAL RESOURCE CHARACTERIZATION

Based on data reviews from existing literature and reports and results of the Phase III Remedial Investigation, including the environmental evaluation field studies, environmental resources at the Site will be characterized. The description of the site will be presented in terms of distinct resource areas as listed below:

- Meteorology/Air Quality
- Soils and Geology
- Surface and Ground Water Hydrology
- Vegetation
- Wildlife
- Aquatic Ecology
- Protected/Important Species and Habitats

The purpose of the resource characterization is to define site conditions as they currently exist without remediation. The narrative with supporting data will include descriptions of each resource with attendant tables and figures, as appropriate, to depict in a concise and clear fashion site conditions and ecological relationships, particularly as site characteristics influence transport mechanisms and provide pathways to ecological receptors.

4.2 CONTAMINANT SOURCE AND RELEASE CHARACTERIZATION

Existing physical and chemical data along with that collected under this plan for various media will be used to characterize contaminant source areas and release characteristics at the Site. The types of chemicals and their concentrations will be displayed in various formats, such as:

- Maps showing areal extent of source(s)
- Hydrogeologic cross sections showing vertical extent of contaminant sources
- Tables showing contaminants and concentrations at the source

A written discussion, which will accompany the above support tables and figures, will present evaluation of potential maximum concentrations of chemicals at the source for use in the fate and transport assessment (Section 5.0). Analytical data will also be placed in a computer data base for use in the environmental risk assessment.

The existing chemical data and that to be collected during the Phase III RI and ecological assessment will also be reviewed to see if episodic or temporal trends in concentrations are present. The data will be assessed to determine, if possible, whether chemical releases are periodic but acute or long-term but chronic. The data will be displayed in formats that highlight concentration trends versus time and usefulness for performing the environmental risk assessment.

4.3 EXTENT OF CONTAMINATION

Analytical results from soil, ground water, surface water, sediments, and air samples will be entered into a computer data base for later retrieval and processing of the data. It is anticipated that all available data (Phase I, II, III, and data collected under this work plan) will be reviewed and interpreted to establish existing conditions (that is, nature and extent of contamination in the various media).

Examples of formats that may be utilized to display existing conditions are:

- Tables showing contaminant location, type, and concentration
- Maps showing areal extent of contaminants and concentrations
- Cross sections showing vertical extent of contaminants and concentrations
- Data base printouts of detected contaminants for stabilized uses
- Bar graphs showing contaminant levels

A written summary of the nature and extent of contamination will accompany the above supporting figures and tables.

Furthermore, the data used to define the extent of contamination will be presented in formats useful for performing the environmental risk assessment described in Section 5.0.

4.4 ENVIRONMENTAL TRANSPORT PATHWAYS

This task will identify the environmental transport (exposure) pathways that may potentially expose various wildlife receptors located at or near the 881 Hillside site. Exposure pathways consist of four necessary elements:

- A source and mechanism of chemical release to the environment
- An environmental transport medium for the released chemical
- A point of potential wildlife contact with the contaminated medium
- A wildlife exposure route at the point of exposure

All four elements must be present for an exposure pathway to be complete and for exposure to occur. The basic activities will include the following factors:

- Examine the chemical release sources and release media
- Examine the environmental transport media
- Identify exposure points
- Define the chemical intake (exposure routes) for wildlife species

The final step in the exposure pathway analysis is to integrate the release sources, environmental transport media, exposure points, and exposure routes into exposure pathways.

4.5 IDENTIFICATION OF KEY SPECIES

Key species are those organisms that are important in the food chain and represent a major component of energy transfer through the food chain. For the first phase of the ecological assessment of the Site, the key species will be represented by primary producers and lower trophic-level consumers. Results of the site ecological characteristics survey will identify those key species to be sampled for tissue analyses and those species representing logical steps in the potential transfer of contaminants to higher trophic levels, including target species. A review of biological data for the Rocky Flats Plant area suggest that key species for the initial evaluation at the Site could include the following:

- Vegetation
  - Slender Wheatgrass (Agropyron trachycaulum)
  - Green Needlegrass (Stipa viridula)
  - Broad-leaf Cattail (Typha latifolia)
  - American Watercress (Barbarea orthoceras)
  - Baltic Rush (Juncus arcticus)
  - Cordgrass (Spartina pectinata)

- Wildlife
  - Deer Mouse (Peromyscus maniculatus)
  - Meadow Vole (Microtus pennsylvanicus)

- Aquatic Organisms
  - Periphyton
  - Benthos (including annelids and insecta)

5.0
ENVIRONMENTAL RISK ASSESSMENT

Evaluating environmental risk requires assessing the chemical exposures and wildlife species under consideration. Of specific importance in this evaluation are the identification of specific exposure points, the concentrations of chemicals at those points (which is based in part on environmental fate and transport), and the identification of species that are present at the exposure point. The ecological risk is based on existing environmental criteria, published toxicological literature, and existing site-specific environmental evaluations. The approach for each of these areas is described below.

5.1 CHEMICAL EXPOSURE POINTS

Exposure point identification is one of the steps in defining an exposure pathway. The exposure pathway work plan was given in subsection 4.4. The exposure point is the specific location where chemical contaminants that have been released to the environment potentially contact specific wildlife species. Much of this information will come from the activities described in Sections 3.0 and 4.0.

5.1.1 Identification

The identification of exposure points will be based on the environmental fate modeling of the release of chemicals from the Site and the identification of wildlife species present within the immediate location of the exposure points. The exact exposure point may be different for various chemicals released from the source that have different environmental transport and fate properties.

For example, in characterizing the exposure of aquatic organisms to contaminants, particular attention will be paid to the transport and interaction of ground and surface water at the South Interceptor Ditch and Woman Creek, and to surface runoff from the Site area into the ditch. The identification of exposure points is closely related to the identification of wildlife species that are potentially exposed at an exposure point.

5.1.2 Concentrations

The concentrations of indicator chemicals (those chemicals that are determined to have the greatest impact) will be determined by environmental fate and transport modeling or actual environmental media sampling for each

exposure point. The chemical concentrations identified will be used to evaluate the ecological risks to identified receptor species. The chemical concentrations will be determined for each complete exposure pathway defined in subsection 4.4.

5.1.3 Fate and Transport

The intrinsic chemical and physical properties of the selected chemicals determine their transport by the exposure pathways identified in subsection 4.4. The chemical transport and fate will be evaluated using procedures recommended in the Environmental Protection Agency's (EPA) Superfund Exposure Assessment Manual (1988).

5.2 ECOLOGICAL RISK

Ecological risks will be determined by comparing exposure point concentrations to applicable or relevant and appropriate requirements (ARAR) and by performing site-specific toxicological analyses and comparisons.

5.2.1 Risk Criteria

The risk criteria used to determine whether there are ecological impacts will be ARARs or site-specific criteria based on published toxicological research. An important ARAR will be EPA's National Ambient Water Quality Criteria that is protective of wildlife. More site-specific criteria may be developed based on wildlife sampling and analysis. These data may provide bioaccumulation and bioconcentration factors that are used in deriving site-specific risk criteria. The derived biological factors would be supplemented with information taken for pertinent published literature.

5.2.2 Risk Characterization

A quantitative characterization of ecological risks due to chemicals of concern released from the Site area will have the following three components:

1. Comparison of measured or predicted concentrations of single contaminants at exposure points to ARARs.

2. Comparison to the results of bioaccumulation assays performed on samples of key species. These assays will measure any accumulation of chemicals of concern in the tissues of indicator organisms (vegetation, small mammals, and aquatic life). Evidence of bioaccumulation would suggest possible food chain transfer and indicate the need for evaluation of the effects of bioaccumulation.

3. Toxicity assessments will be made to estimate the potential risk to selected wildlife species from the chemical concentrations present at exposure points. The toxicity assessments will be based on published literature studies and any site-specific information that is available.

6.0
REMEDIATION CRITERIA

Comparisons of observed concentrations will be made with existing environmental criteria such as national ambient water quality criteria that are protective of wildlife. In addition, remedial criteria will be derived from risk information developed for use under other environmental statutes or by direct comparison to published toxicological literature when that information is available.

7.0
ENVIRONMENTAL EVALUATION REPORT

At the conclusion of the ecological assessment, an Environmental Evaluation Report will be prepared in a clear and concise manner to present study results and interpretation. All relevant data from this assessment, previous investigations, and the Phase III RI data, will be incorporated and evaluated in the characterization of potential environmental risk. The following topics will be covered in the report, and a detailed outline is presented in Appendix A:

- Objectives
- Scope of Investigation
- Site Description
- Contaminants of Concern
- Exposure Characteristics
- Risk Characteristics
- Remediation Criteria
- Conclusions and Limitations

APPENDIX A
DRAFT ENVIRONMENTAL EVALUATION REPORT OUTLINE
881 HILLSIDE

1.0 INTRODUCTION

- 1.1 OBJECTIVES
- 1.2 SITE HISTORY
- 1.3 SCOPE OF EVALUATION

2.0 SITE DESCRIPTION

- 2.1 PHYSICAL ENVIRONMENT
- 2.2 BIOTIC COMMUNITY
  - 2.2.1 Freshwater Community
  - 2.2.2 Terrestrial Community

3.0 CONTAMINANT SOURCES AND RELEASES

- 3.1 SOURCES
- 3.2 RELEASES

4.0 CONTAMINANTS OF CONCERN

- 4.1 INDICATOR CHEMICAL SELECTION PROCESS
  - 4.1.1 Chemicals of Importance in the Biota Remedial Investigation
- 4.2 INDICATOR CHEMICALS SELECTED FOR THE ECOLOGICAL EVALUATION

4.0 GEOLOGICAL EXPOSURE

- 4.1 ENVIRONMENTAL TRANSPORT PATHWAYS
- 4.2 EXPOSURE POINT IDENTIFICATION
  - 4.2.1 Soil
  - 4.2.2 Water
  - 4.2.3 Vegetation
- 4.3 CHEMICAL FATE AND TRANSPORT
  - 4.3.1 Fate and Transport